	Search Text
1	"5021999"
2	(("5021999") or ("5027171") or ("5111430") or ("5253196") or ("5293560") or ("5317535") or ("5388069") or ("5424993") or ("5430670") or ("5434815") or ("5438544") or ("5467306") or ("5477485") or ("5485422") or ("5493140") or ("5508543") or ("5627781") or ("5670790") or ("5714766") or ("5754477")).PN.
3	((("5021999") or ("5027171") or ("5111430") or ("5253196") or ("5293560") or ("5317535") or ("5388069") or ("5424993") or ("5430670") or ("5434815") or ("5438544") or ("5467306") or ("5477485") or ("5485422") or ("5493140") or ("5508543") or ("5627781") or ("5670790") or ("5714766") or ("5754477")).PN.) and (nano near2 crystal$8)
4	("438/452").CCLS.
5	(("438/452").CCLS.) and (oxid$8 near7 temperature$2)

threshold
voltages, it may be necessary to tolerate more leakage current than desired or
accept less area efficiency. Several solutions have been identified to
minimize such trade-offs. For example, field oxide growth under High Pressure
Oxidation can limit dopant diffusion by reducing the oxide growth temperature
while sustaining a high rate of oxidation; and a combined germanium-boron
implant favorably reduces the born diffusion rate, thereby reducing the loss of
boron by diffusion into the oxide and by lateral diffusion. It is also well
known that with a chlorine implant the oxidation rate can be increased and the
time required for oxide growth shortened. That is, by growing the field oxide
faster there is less time for a highly mobile dopant species such as boron to
diffuse into the oxide and, overall, a lower implant dose can be used to create
the channel stop. Lower implant doses result in less lattice damage.

DEPR:
According to the invention it is now recognized that satisfactory net oxide
growth rates suitable for a high volume, cost sensitive, manufacturing
environment, can be sustained while process conditions are sequentially altered

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BSPR:
Numerous problems have been reported in cases where channel stop implants are used in combination with field oxides. See Wolf, Silicon Processing for the VLSI Era, Volume 21, Chapter 2 for a general discussion. Specifically, lattice dislocations generated during channel stop implantation are known to result in stacking faults during subsequent thermal processing such as the aforementioned field oxide growth. When these oxidation induced stacking faults (OISFs) extend into the active regions they can cause leakage currents which degrade device performance. In the past this has meant that certain performance specifications could only be met at the expense of others. Thus, in order to design an isolation structure with minimimally sufficient parasitic

to inhibit OISF's. This is to be distinguished from shrinkage of stacking faults, which has been observed at high temperature, long oxidation conditions. (See Lin, et al., J. Electrochem. Soc.: Solid-State Science And Technology, May 1981.) That is, a sequence of process steps is provided which (1) assures relatively short oxidation cycles suitable for the manufacturing environment, (2) provides acceptable levels of dopant outdiffusion, and (3) inhibits OISF development in the first instance.

DEPR:
The atmosphere is then modified to begin growth of field oxide under high temperature, low oxidation rate conditions. For example, start at 6 percent oxygen, 94 percent nitrogen for approximately 30 minutes, followed by 30 percent oxygen, 70 percent nitrogen for about 15 minutes. To the extent not all of the nucleation sites have been removed during the preceeding anneal step, application of high temperature, low growth rate conditions during initial stages of field oxide growth will minimize creation of OISFs. Variants of these conditions, such as a single, but longer, growth at 10 to 20 percent oxygen content may also provide satisfactory results.

DEPR:
An important feature of the invention runs counter to conventional practice of growing field oxide under conditions which result in undesirable diffusion of dopant species combined with a high oxidation rate. Instead, initial growth of field oxide occurs under high temperature, slow oxidation rate conditions to minimize development of OISF's. Further, according to the invention, accompanying concerns relating to loss of dopant species by high temperature diffusion during the slow oxidation process are mitigated by the aforementioned anneal which drives the dopant distribution away from the oxide 44 and deeper into the device layer. The structure 10 with growth of the minor portion 56 of field oxide, e.g., 200 Angstroms or more, is shown in FIG. 1j. It is characterized by a highly efficient channel stop implant and a low defect density in portions of the device layer 20 beneath the field oxide.

DEPR:
The structure 10 is next subjected to a higher oxidation rate to complete the field oxide growth. The majority of field oxide growth proceeds under high temperature conditions, e.g., 1050 C., for 180 minutes in steam. The temperature is then gradually decreased (3 degrees C. per

minute) to 700 C. and
at that point the wafer structure having field oxide formations 62, commonly
one micron thick, is pulled from the furnace. See FIG. 1k. Experimental data
indicates that performing the rapid field oxide growth after growth under the
high temperature, slow oxidation rate conditions does not adversely affect the
defect density of the device layer. Specifically, the density of OISFs under
the field oxide formations 62, in the region of p-type channel stop implants,
has been measured as low as 5 per cm2 through the device layer 20. This is to
be compared to OISF densities observed in conventionally processed field oxides
exceeding 1E6/cm2.

DEPR:
A process has been described which inhibits OISFs and yet provides net oxide
growth rates suitable for a high volume, cost sensitive, manufacturing
environment. Numerous variations of the invention apart from the disclosed
embodiments will be apparent. For example, the aforedescribed anneal to be
performed in the nitrogen atmosphere at 1050 C. for 75 minutes need not occur
in an inert environment. The anneal could also be performed in an oxidizing
ambient that shrinks OISFs, such as a high temperature, low